

Lemonade Stand: Solving Practical Problems Using Linear Inequalities in One Variable

- Strand:** Equations and Inequalities
- Topic:** Use linear inequalities in one variable to solve practical problems
- Primary SOL:** A.5 The student will
- a) solve multistep linear inequalities in one variable algebraically and represent the solution graphically;
 - c) solve practical problems involving inequalities;
- Related SOL:** 6.14, 7.13, 8.18

Materials

- Method for students to visually display their work
- Solving Multi-Step Linear Inequalities activity sheet (attached)

Vocabulary

inequality symbol, linear inequality, properties of inequality, solution set

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Display the following problem:
A local organization decided to set up a lemonade stand to raise money to help fight childhood cancer. Their plan was to donate two-thirds of any money collected to the cause and keep the remainder to cover expenses. As the group was setting up, they had a young man stop by to make a flat donation of \$60. If the group is selling each cup of lemonade for \$0.75 and they have already collected \$60, how many cups will they need to sell in order to raise at least \$100 to donate to the cause?
 - Write an inequality that could be used to calculate the number of cups the group would need to sell.
 - Solve this inequality, and graph the solution set on a number line.
 - Name at least three different solutions that are represented by your graph.
2. Students should be given ample time to work with partners or in small groups to answer the problem. As they work, circulate and look for evidence of different inequalities that could be used, such as ...

$$\frac{2}{3}(60 + 0.75c) \geq 100$$

$$\frac{2}{3}(60) + \frac{2}{3}(0.75c) \geq 100$$

$$60 + 0.75c \geq 150$$

$$40 + 0.50c \geq 100$$

All of these inequalities produce the solution $c \geq 120$.



The organization will need to sell at least 120 cups of lemonade.

They will reach their goal if they sell 120 cups, 121 cups, 122, cups, ...

3. When everyone is finished, select groups to share their work with the remainder of the class in order to highlight different approaches that all result in the same solution set.
4. As groups share their work, highlight the properties of real numbers and properties of inequality that are being applied.
5. Distribute the Solving Multistep Inequalities activity sheet and allow students to work with a partner to answer the questions presented. The teacher can circulate to check for accuracy and provide assistance, as needed.

Assessment

- **Questions**

- How would the number of cups of lemonade change if the young man who stopped by and made a donation had donated \$100, instead of \$60? What is the minimum number of cups that the organization would have to sell in order to reach their goal with this even more generous donation?
- What would be one inequality, that could be solved in a minimum of three steps, that would match the solution set graphed below?



- How could you create an inequality that would apply the subtraction property of inequality and the multiplication property of inequality?

- **Journal/writing prompts**

- Compare and contrast the multiplication and division properties of equality with the multiplication and division properties of inequality.
- Explain what the words “at most” and “at least” mean in relation to writing an inequality. Give examples to help with your explanation.

- **Other Assessments**

- If the teacher tapes a number line on the floor of the classroom (or the hallway), students could be instructed to stand on a solution that would be included in the solution set for a given linear inequality.

Extensions and Connections (for all students)

- Have students research the cost and profit involved with selling a product similar to the refreshments served at a lemonade stand. Have them determine whether the organization was making money for themselves as well as the childhood cancer organization from each cup of lemonade sold. Does that answer change if the group had not had someone stop by to make a flat donation?
- Students can take a photo of something in their community that could be related to an inequality and write a short essay explaining how it relates to their algebra studies.

Strategies for Differentiation

- Begin the lesson with a similar scenario where the organization is donating all proceeds to help fight childhood cancer. Move from this two-step inequality to the multistep one listed.
- Help students to transform this multistep inequality into a two-step inequality by asking questions like, “How much of the man’s \$60 donation will actually go toward the campaign to fight childhood cancer?” “How much money will be donated from each cup of lemonade sold?”

Note: The following pages are intended for classroom use for students as a visual aid to learning.

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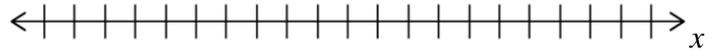
Solving Multistep Linear Inequalities

Name _____

Date _____

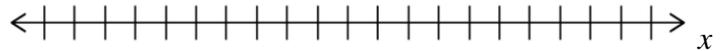
Directions: Solve each inequality in the space provided, graph the solution set on the blank number line provided, and list three possible solutions for each.

1.) $9x - 5 > -2(x - 3)$



Three possible solutions: _____, _____, _____

2.) $5x - 5 - 9x < 3$



Three possible solutions: _____, _____, _____

3.) $3x - 5(x + 1) \geq -7$



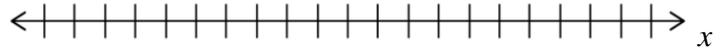
Three possible solutions: _____, _____, _____

4.) $\frac{3}{4}x - 10 + \frac{3}{8}x \leq \frac{1}{8}$



Three possible solutions: _____, _____, _____

5.) $\frac{3x-5}{8} > \frac{1}{2}$



Three possible solutions: _____, _____, _____

For each question below, write an inequality that could be used to answer the question. Then, solve each by applying the properties of real numbers and properties of inequality.

- 6.) Matthew has \$1,500 in his savings account. Currently, he pays \$20 each month for an app that he has subscribed to and \$30 each month at his favorite Italian restaurant. If he does not spend money on anything else or make any other deposits into his savings account, for how many months can he continue to make these purchases without going into debt?

- 7.) My twin sisters, Laura and Layla, just celebrated their birthday. At our family celebration, one set of grandparents gave them each a gift card. The other set of grandparents gave them each a \$50 check. Laura and Layla would not tell me how much was on their gift cards, just that combined they have a total of at least \$160 from our two sets of grandparents. What are the possible values for the gift card each of my sisters received?
- 8.) A submarine started at sea level and descended at a rate of -32 feet per minute for a given period of time, x . Then, the submarine slowed its descent to a rate of -12 feet per minute for another interval that lasted the same amount of time. If the current position of the submarine is, at most, 480 feet below sea level, describe the solution set for the number of minutes the submarine was travelling at each of these different speeds.
- 9.) Company A has a cellphone plan that charges a monthly fee of \$15 in addition to the \$0.40 they charge per minute for calls. Company B does not charge a monthly fee, but they charge \$0.50 per minute for calls. In a given month, describe the scenarios where Company B's plan would be less expensive.